

CLAIMS

1. A method of electrochemical treatment such as electroplating, etc. characterized in that electrochemical reaction is executed in a state of a supercritical or subcritical state of a reaction vessel (6) storing an electrolytic solution (1) therein.
2. A method of electrochemical treatment such as electroplating, etc. according to claim 1, wherein said reaction vessel (6) is emulsified through a surface active agent (41) and then said electrochemical reaction is executed in the emulsified state.
3. A method of electrochemical treatment such as electroplating, etc. according to claim 1, wherein matter (5) in a supercritical or subcritical state is introduced into said reaction vessel (6) before an electrode (4) or electrolytic solution (1) is electrolyzed in said reaction vessel (6) and thereafter said electrode (4) is cleaned or an oxide film is removed therefrom.
4. A method of electrochemical treatment such as electroplating, etc. according to claim 1, wherein said matter (5) in the supercritical or subcritical state is shifted into a state equal to the critical point or lower after execution of said electrochemical reaction.
5. A method of electrochemical treatment such as electroplating, etc. according to claim 1, wherein said matter (5) in the supercritical or

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subcritical state is introduced into said reaction vessel (6) after electrolyzing said electrode (4) or electrolytic solution (1) and then said electrode (4) is cleaned or dried.

6. A method of electrochemical treatment such as electroplating, etc. according to claim 1, wherein reservoir vessels (25) to (27) communicable with said reaction vessel (6) are disposed at the outside of said reaction vessel (6), and said used-supercritical or subcritical matter (5), said electrolytic solution (1) or cleaning or oxide film removed-matter (18) is reserved in said reservoir vessels (25) to (27).

7. A method of electrochemical treatmentsuch as electroplating, etc. according to claim 1, wherein said used-supercritical or subcritical matter (5) reserved in said reservoir vessels (25) to (27) is reproduced and refluxed to said reaction vessel (6), or said used electrolytic solution (1) or cleaning or oxide film removed-matter (18) reserved in said reservoir vessels (25) to (27) is reproduced and refluxed to said solution reservoir vessels (16), (17), (19).

8. A method of electrochemical treatment such as electroplating, etc. according to claim 1, wherein a treatment process of deposition and adhesion of said electrode (4) and a preceding treatment process thereof, or an electrolyzing process of said electrolytic solution (1) and a preceding treatment process thereof are executed in only one reaction vessel (6).

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9. A method of electrochemical treatment such as electroplating, etc. according to claim 1, wherein said matter (5) to be shifted into a supercritical or subcritical state is at least one selected from the group of carbon dioxide, methane trifluoride, ethane, propane, butane, benzene, methylether and chloroform.

10. A method of electrochemical treatment such as electroplating, etc. according to claim 1, wherein said electrochemical reaction is electroplating, electroforming, formation of an anodic oxide film, electrochemical machining, electrochemical polishing, electrophoretic coating, electrorefining, chemical conversion treatment, or electroless plating.

11. A method of electrochemical treatment such as electroplating, etc. in which electrochemical reaction is executed in a reaction vessel (6) storing an electrolytic solution (1) and an electrode (4) therein, said method being characterized in that the electrochemical reaction is executed by pressurizing said reaction vessel (6).

12. A method of electrochemical treatment such as electroplating, etc according to claim 11, wherein a pressurized fluid is introduced into said reaction vessel (6) and said reaction vessel (6) is pressurized to a level equal to or higher than the atmospheric pressure but equal to or lower than a supercritical pressure of said pressurized fluid.

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13. A method of electrochemical treatment such as electroplating, etc. according to claim 11, wherein said reaction vessel (6) is emulsified through a surface active agent (41) and then said electrochemical reaction is executed in the emulsified state.

14. A method of electrochemical treatment such as electroplating, etc. according to claim 12, wherein before electrolyzing said electrode (4) or electrolytic solution (1), said pressurized fluid is introduced to clean said electrode (4) or remove an oxide film therefrom.

15. A method of electrochemical treatment such as electroplating, etc. according to claim 12, wherein after electrolyzing said electrode (4) or electrolytic solution (1), said pressurized fluid is introduced into said reaction vessel (6) to clean or dry said electrode (4).

16. A method of electrochemical treatment such as electroplating, etc. according to claim 12, wherein reservoir vessels (25) to (27) communicable with said reaction vessel (6) are disposed at the outside of said reaction vessel (6), and said used-pressurized fluid, said electrolytic solution (1) or cleaning or oxide film removed-matter (18) is reserved in said reservoir vessels (25) to (27).

17. A method of electrochemical treatment such as electroplating, etc. according to claim 12, wherein said used-pressurized fluid reserved in said reservoir vessels (25) to (27) is reproduced and refluxed to said reaction

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vessel (6), or said used-electrolytic solution (1) or cleaning or oxide film removed-matter (18) reserved in said reservoir vessels (25) to (27) is reproduced and refluxed to said solution reservoir vessel (16), (17), (19).

18. A method of electrochemical treatment such as electroplating, etc. according to claim 11, wherein a treatment process of deposition and adhesion of said electrode (4) and a preceding treatment process thereof, or an electrolyzing process of said electrolytic solution (1) and a preceding treatment process thereof are executed in only one reaction vessel (6).

19. A method of electrochemical treatment such as electroplating, etc. according to claim 12, wherein said pressurized fluid is at least one selected from the group of carbon dioxide, fats and oils, hexane, toluene, benzene, chloroform, nitrogen and argon.

20. A method of electrochemical treatment such as electroplating, etc. according to claim 11, wherein said electrochemical reaction is electroplating, electroforming, formation of an anodic oxide film, electrochemical machining, electrochemical polishing, electrophoretic coating, electrorefining, chemical conversion treatment, or electroless plating.

21. An apparatus of electrochemical reaction of electroplating, etc. characterized by including a reaction vessel (6) capable of storing an electrolytic solution (1), said reaction vessel (6) being disposed such that a

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supercritical or subcritical state can be formed and electrochemical reaction can be executed in said critical state.

22. An apparatus of electrochemical reaction of electroplating, etc. according to claim 21, wherein matter (5) in a supercritical or subcritical state is disposed such that said matter (5) can be introduced into said reaction vessel (6) before electrolyzing an electrode (4) or electrolytic solution (1) stored in said reaction vessel (6), so that said electrode (4) can be cleaned or an oxide film can be removed therefrom.

23. An apparatus of electrochemical reaction of electroplating, etc. according to claim 21, wherein said matter (5) in a supercritical or subcritical state can be shifted into a state equal to or lower than said critical point after said electrochemical reaction is executed.

24. An apparatus of electrochemical reaction of electroplating, etc. according to claim 21, wherein said matter (5) in a supercritical or subcritical state is disposed such that said matter (5) can be introduced into said reaction vessel (6) after electrolyzing said electrode (4) or electrolytic solution (1), so that said electrode (4) can be cleaned or dried.

25. An apparatus of electrochemical reaction of electroplating, etc. according to claim 21, wherein reservoir vessels (25) to (27) communicable with said reaction vessel (6) are disposed at the outside of said reaction vessel (6), so that said used-supercritical or subcritical matter (5), said

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electrolytic solution (1) or cleaning or oxide film removed-matter (18) can be reserved in said reservoir vessels (25) to (27).

26. An apparatus of electrochemical reaction of electroplating, etc. according to claim 21, wherein said used-supercritical or subcritical matter (5) reserved in said reservoir vessels (25) to (27) is reproduced and refluxed to said reaction vessel (6), and said used-electrolytic solution (1) or cleaning or oxide film removed-matter (18) reserved in said reservoir vessels (25) to (27) is reproduced and refluxed to said solution reservoir vessel (16), (17), (19).

27. An apparatus of electrochemical reaction of electroplating, etc. according to claim 21, wherein a treatment process of deposition and adhesion of said electrode (4) and a preceding treatment process thereof, or an electrolyzing treatment process of said electrolytic solution (1) and a preceding treatment process thereof can be executed in only one reaction vessel (6).

28. An apparatus of electrochemical reaction of electroplating, etc. according to claim 21, including at least two reaction vessels (6), (6a) capable of executing a treatment process of deposition and adhesion of said electrode (4), and preceding and succeeding treatment processes thereof, or an electrolyzing process of said electrolytic solution (1), and preceding and succeeding treatment processes thereof, said preceding and succeeding

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treatment processes being sequentially executed in said reaction vessels (6), (6a).

29. An apparatus of electrochemical reaction of electroplating, etc. according to claim 21, wherein after a prescribed treatment process is executed in said reaction vessels (6), (6a), said electrolytic solution (1), cleaning or oxide film removing matter (18), or surface active agents (39), (40) within said reaction vessel (6) on the side of the preceding treatment process can be moved into said reaction vessel (6a) on the side of the succeeding treatment process.

30. An apparatus of electrochemical reaction of electroplating, etc. according to claim 21, wherein after said electrode (4) is electrolyzed or after said electrolyzed electrode (4) is deposited and adhered to the other electrode (4), multilayer electrode matter can be deposited and adhered to the other electrode (4) using said reaction vessel (6).

31. An apparatus of electrochemical reaction of electroplating, etc. including a reaction vessel (6) capable of storing an electrolytic solution (1) and an electrode (4) therein, electrochemical reaction being able to be executed in said reaction vessel (6), said apparatus being characterized in that said reaction vessel (6) is disposed such that said electrochemical reaction can be executed by pressurizing said reaction vessel (6).

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32. An apparatus of electrochemical reaction of electroplating, etc. according to claim 31, wherein a pressurized liquid can be introduced into said reaction vessel (6) and said reaction vessel (6) is pressurized to a level equal to or higher than the atmospheric pressure but equal to or lower than a supercritical pressure of said pressurized liquid.

33. An apparatus of electrochemical reaction of electroplating, etc. according to claim 31, wherein before electrochemical reaction of said reaction vessel (6) is executed, said pressurized liquid can be introduced into said reaction vessel (6) and said used-pressurized liquid can be discharged from said reaction vessel (6).

34. An apparatus of electrochemical reaction of electroplating, etc. according to claim 31, wherein said pressurized liquid can be introduced into said reaction vessel (6) before electrochemical reaction of said reaction vessel (6) is executed, so that said electrode (4) can be cleaned or an oxide film can be removed therefrom.

35. An apparatus of electrochemical reaction of electroplating, etc. according to claim 31, wherein said pressurized liquid can be introduced into said reaction vessel (6) after electrochemical reaction of said reaction vessel (6) is executed, so that said electrode (4) can be cleaned or dried.

36. An apparatus of electrochemical reaction of electroplating, etc. according to claim 31, wherein reservoir vessels (25) to (27) communicable

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with said reaction vessel (6) are disposed at the outside of said reaction vessel (6), and said used-pressurized liquid, electrolytic solution (1) or cleaning or oxide film removed-matter (18) is reserved in said reservoir vessels (25) to (27).

37. An apparatus of electrochemical reaction of electroplating, etc. according to claim 31, wherein said used-pressurized liquid reserved in said reservoir vessels (25) to (27) is reproduced and refluxed to said reaction vessel (6), or said used-electrolytic solution (1) or cleaning or oxide film removed-matter (18) reserved in said reservoir vessels (25) to (27) is reproduced and refluxed to said solution reservoir vessel (16), (17), (19).

38. An apparatus of electrochemical reaction of electroplating, etc. according to claim 31, wherein said electrochemical reaction and preceding and succeeding treatment processes thereof can be executed in only one reaction vessel (6).

39. An apparatus of electrochemical reaction of electroplating, etc. according to claim 31, including at least two reaction vessels (6), (6a) capable of executing a treatment process of deposition and adhesion of said electrode (4), and preceding and succeeding treatment processes thereof, or an electrolyzing process of said electrolytic solution (1), and preceding and succeeding treatment processes thereof, said preceding and succeeding treatment processes being sequentially executed in said reaction vessels (6), (6a).

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40. An apparatus of electrochemical reaction of electroplating, etc. according to claim 39, wherein after a prescribed treatment process is executed in said reaction vessels (6), (6a), said electrolytic solution (1), cleaning or oxide film removing matter (18), or surface active agents (39), (40) within said reaction vessel (6) on the side of the preceding treatment process can be moved into said reaction vessel (6a) on the side of the succeeding treatment process.

41. An apparatus of electrochemical reaction of electroplating, etc. according to claim 31, wherein after said electrode (4) is electrolyzed or after said electrolyzed electrode (4) is deposited and adhered to the other electrode (4), multilayer electrode matter can be deposited and adhered to the other electrode (4) using said reaction vessel (6).

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